

# RainCube: a New Paradigm to Observe Weather Processes (NASA Hyper-wall)

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RainCube  
oooo

Ancillary  
o

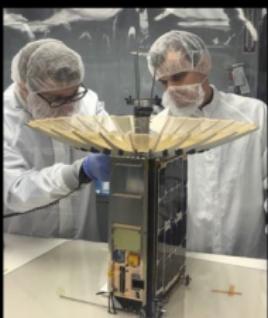
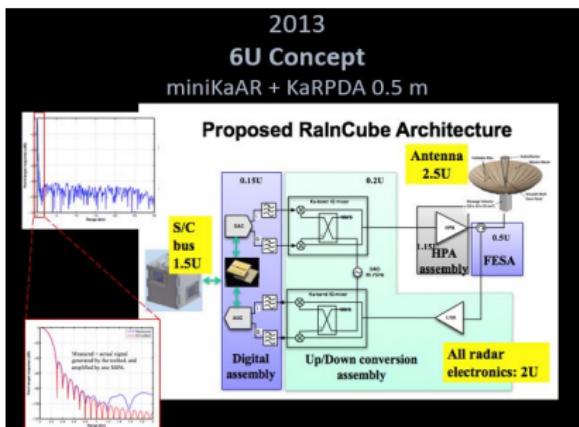
RainCube-NEXRAD  
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RainCube-GPM  
oo

Conclusions  
oo

July 24, 2019

# Radar in a CubeSat: PI Dr. Eva Peral, radar/JPL



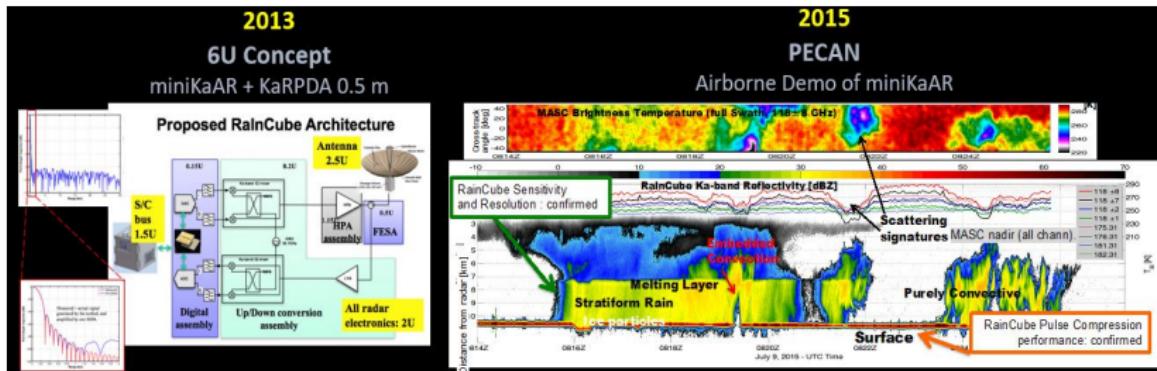
	RainCube
Frequency	35.75 GHz
Antenna size	0.5 m
Sensitivity	13 dBZ
Hor. Resolution	8 km
Range Res	250 m
Beams	1 (nadir)
RF Power	10 W
Processing	Pulse compression

## Tech demo objectives

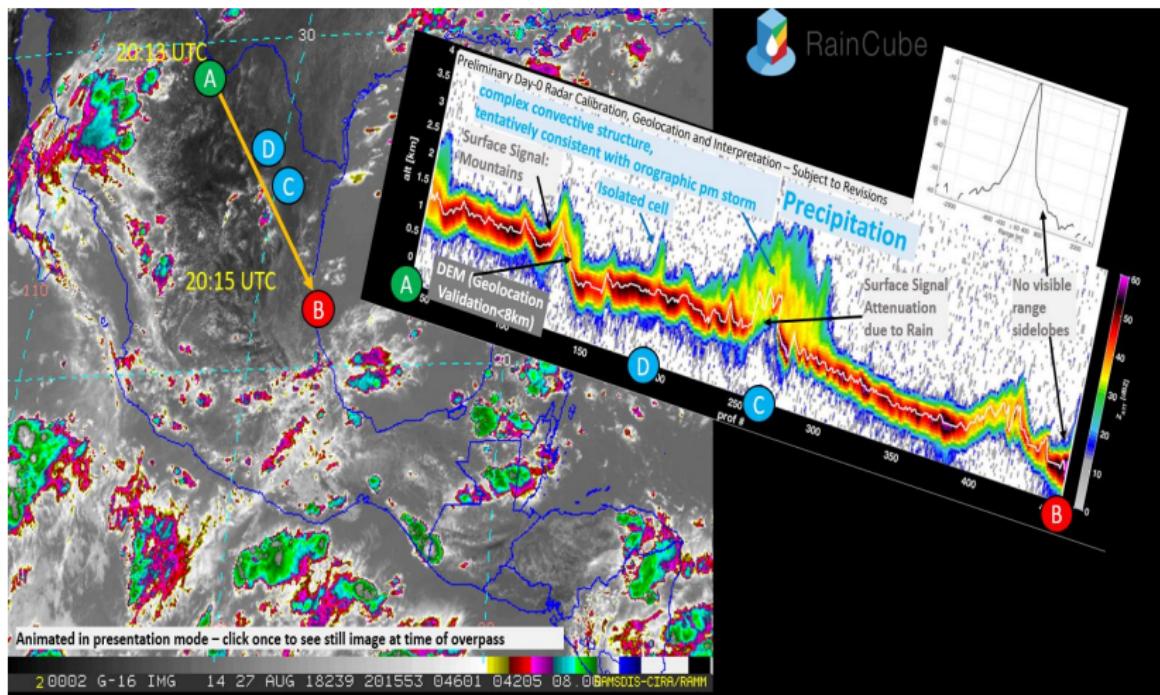
Can such a radar, in LEO (400 km),

- detect precipitation?
- capture the vertical structure of storms?

# RainCube: PI Eva Peral, radar/JPL, launch&ops/Tyvak

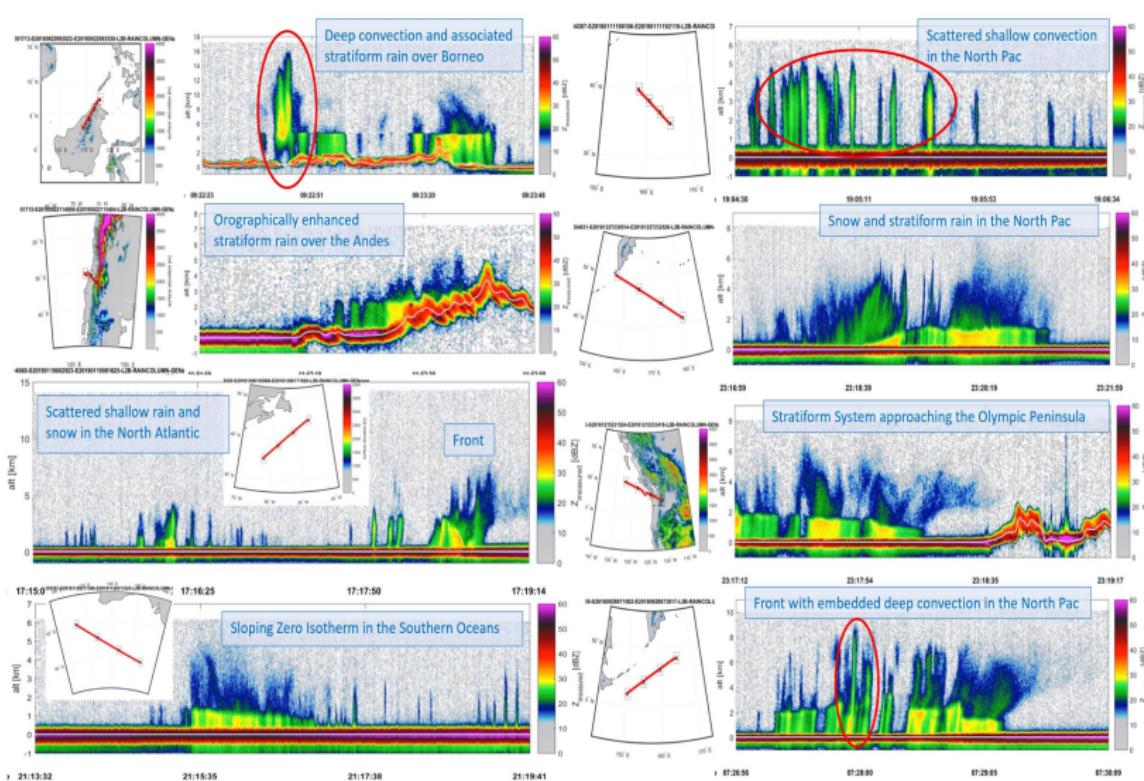


# 1<sup>st</sup> detection of rain: 27 Aug 2018, Sierra Madre, Mexico

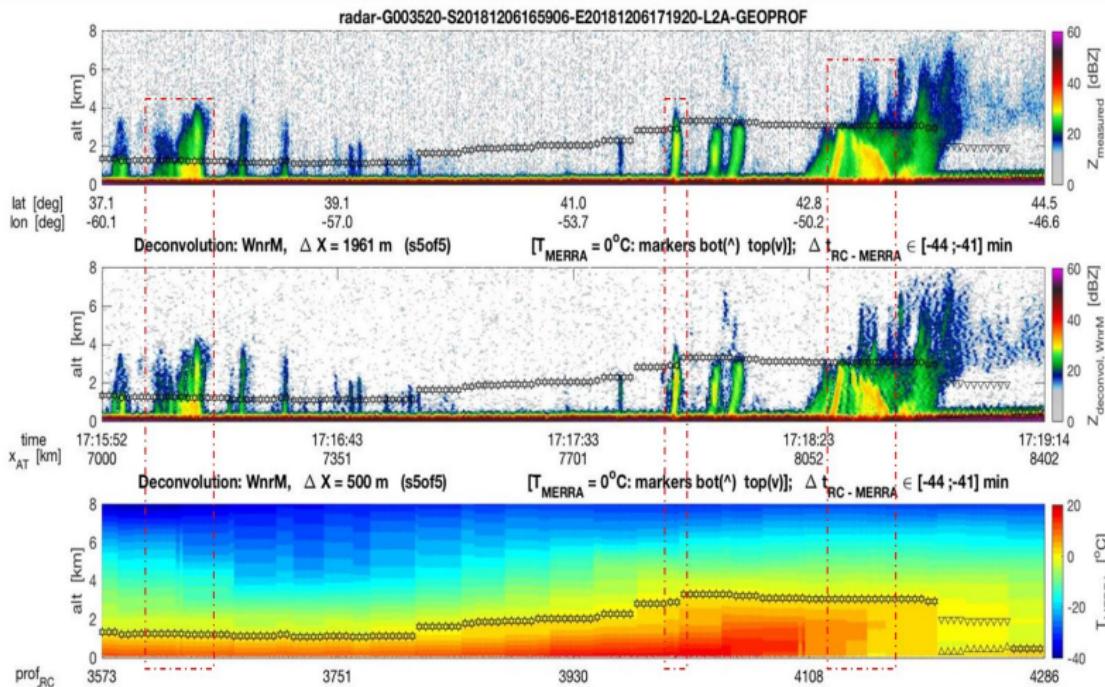


*Fast growing orographic precipitation developed shortly before RainCube's pass*

# RainCube collection of storms



# Storms in their environment (NASA MERRA\_3d\_inst3\_asm, $0.5^\circ \times 0.625^\circ \times 72$ )



✓ Environmental context from reanalysis

RainCube  
○○○○

Ancillary  
○

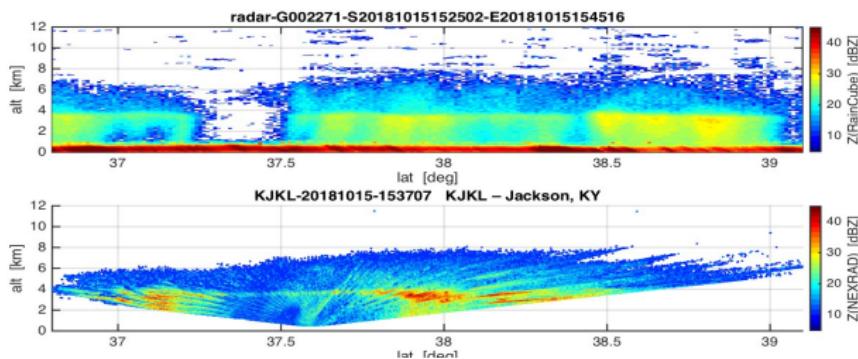
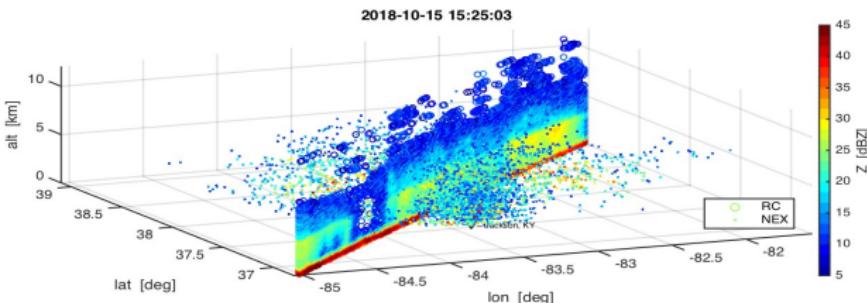
RainCube-NEXRAD  
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RainCube-GPM  
○○

Conclusions  
○○

Approach

# Co-location to NEXRAD (intended for rain rate retrievals)



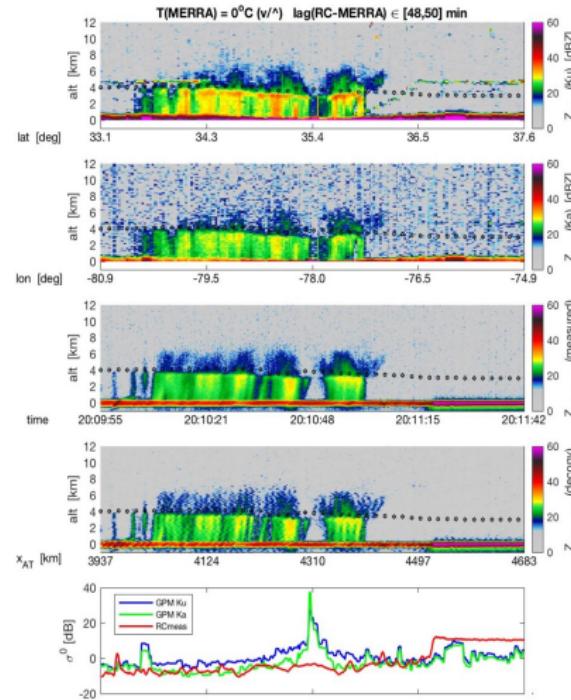
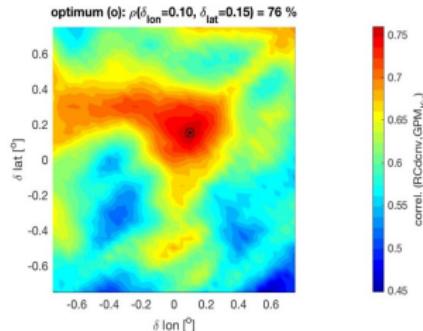
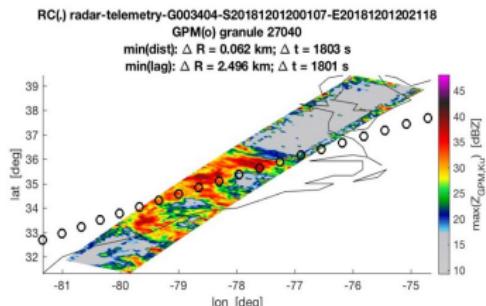
Complementarity

≠ viewing geometries, ≠ frequencies

RainCube  
○○○○Ancillary  
○RainCube-NEXRAD  
○RainCube-GPM  
●○Conclusions  
○○

Approach

# RainCube-GPM/DPR (NASA/JAXA, Dec 1<sup>st</sup> 2018, 20:01:07, N. Carolina)



GPM

Ku

Ka

RainCube

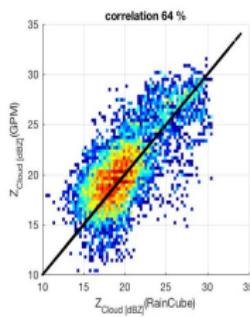
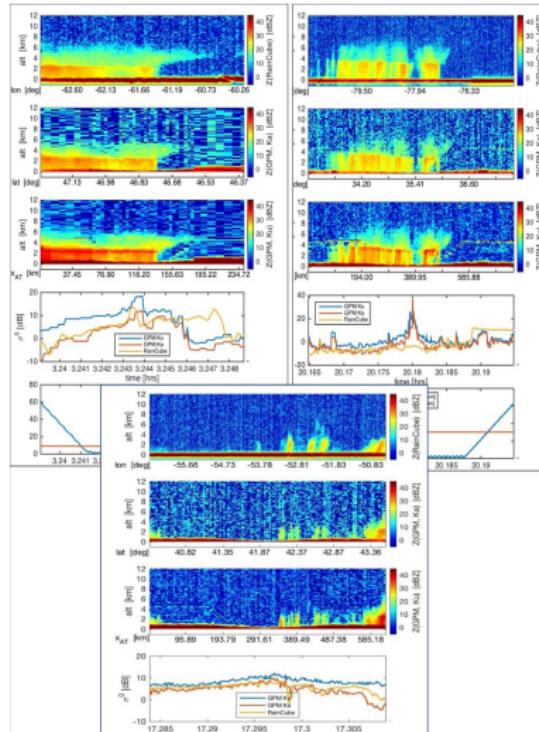
measured

deconvol.

NRCS

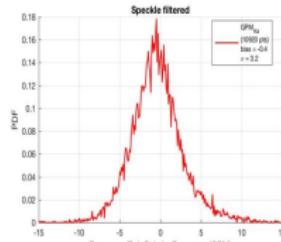
✓ 1-to-1 comparisons of  $Z$  and  $\sigma^0$

# RainCube vs GPM/DPR-relative calibration validation



## Bias RainCube vs DPR Ka

- $|Bias| < 1.5 \text{ dB}$
- $|Bias| \ll \sigma$



## Outcomes:

→ no calibration correction planned for next public release of science data

→ inclusion of this assessment in the product document for user awareness

# Summary

- RainCube: 1<sup>st</sup> spaceborne precipitation radar in a CubeSat
  - ① new implementation of observations of clouds & precipitation
  - ② spaceborne C&P radars = RainCube, GPM-DPR, CloudSat
- Mission
  - ① prime mission ⇒ demonstrated **radar capability**
  - ② extended mission ⇒ validation of **pointing & calibration**  
⇒ grows dataset for **science studies**
- Scientific community
  - engaged to demonstrate value of **combined observations**

RainCube (radar in a *CubeSat*) cloud & precipitation profiling:  
comparable performance to a *subset of GPM-DPR*

Full potential of RainCube technology hinges upon deployment of multiple units in a (multiple) train(s)

RainCube  
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Conclusions

Ancillary  
o

RainCube-NEXRAD  
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RainCube-GPM  
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Conclusions  
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# Thank you!

For more information:

data: <https://tcis.jpl.nasa.gov/data/raincube/>

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